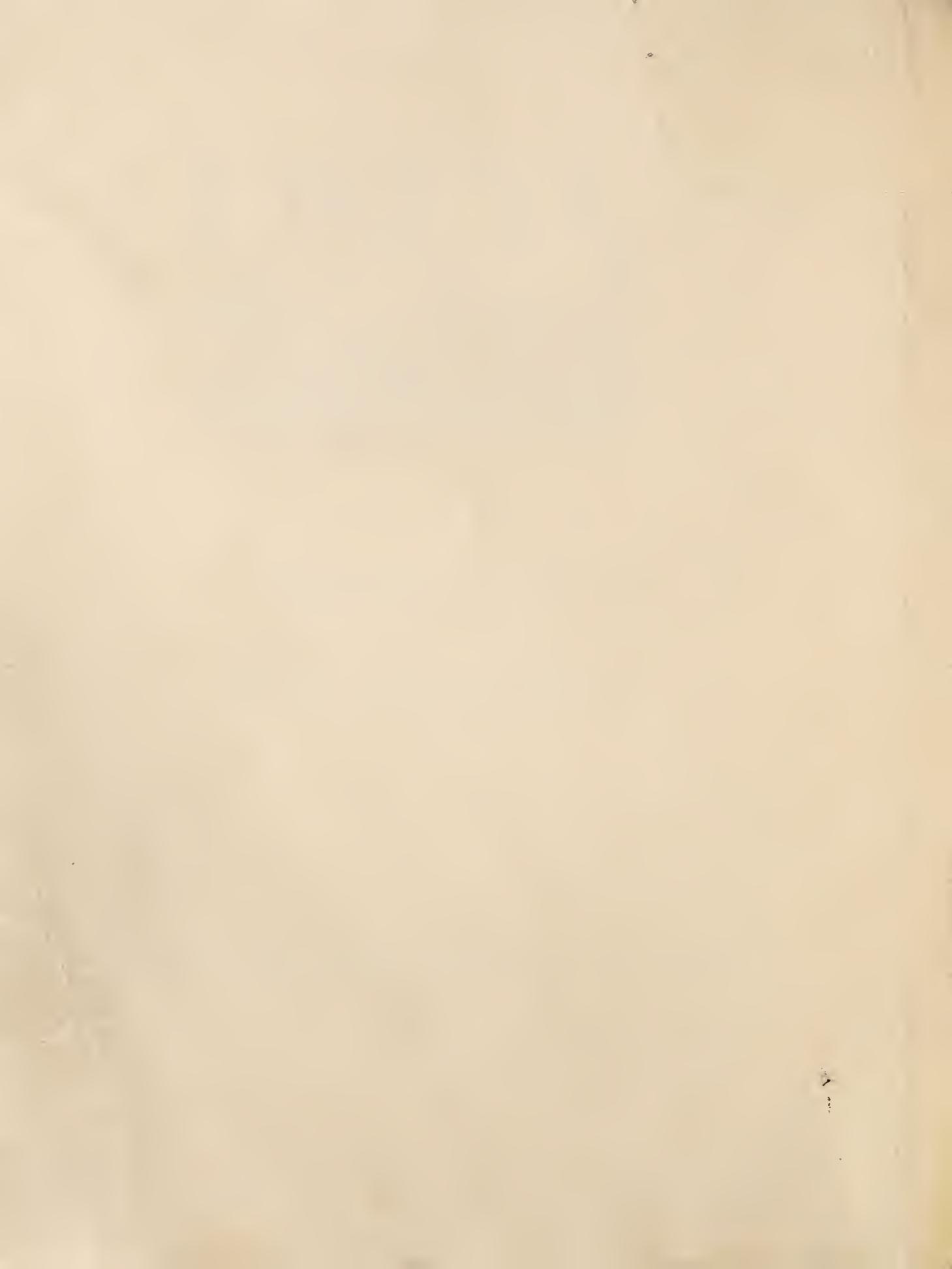


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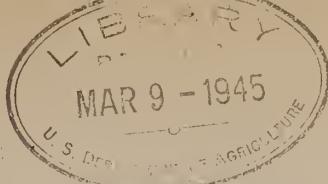
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AIC-10



INFORMATION SHEET ON FROZEN PORK AND BEANS OF THE TOMATO-SAUCE TYPE

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Satisfactory frozen pork and beans of the tomato-sauce type have been prepared in this Laboratory by the formula and method presented below. This formula is a modification of the canned pork-and-bean formula contained in the Quartermasters' Specifications (CQD No. 51, Amendment 1, June 19, 1942).

Formula and Procedure

Yield: About 1,775 one-pound packages.

Equipment: Steam or water blancher, vats for soaking the beans, retort, open or jacketed kettle, and packaging equipment.

Ingredients:

Beans: .415 pounds.

Pork: 56 pounds of trimmed meat.

Sauce:

Tomato puree (1.035 sp. gr. basis).....	270 lb. (31 gal.)
Sugar.....	47 lb.
Salt.....	17-1/4 lb.
Onions, fresh (ground).....	6 lb.
Allspice, whole.....	6 oz.
Cinnamon, whole.....	7 oz.
Clove, whole.....	6 oz.
Mace, whole.....	4 oz.
Fat from the cooked pork.....	Amount available
Cornstarch.....	13-1/2 lb.
Pectin, citrus, slow-set (100 grade basis).....	5-1/4 lb.
Water to make 100 gal. of mixture weighing about 900 lb. Add 48 gal. (400 lb.) before cooking; then make up to volume after cooking.	

Procedure:

Beans: Blanch small white beans for 4 minutes at 170° F. Then soak in soft, cold water about 16 hours, changing the water three times during the soaking period. Drain and cook in wire baskets 50 minutes at 15 pounds steam pressure. Longer cooking yields a darker-brown bean but reduces the thiamin (Vitamin B₁) content.

Pork: Cut the pork into 1/2-ounce pieces and cook in a covered pan in a retort for 30 minutes at 15 pounds steam pressure.

Sauce: Tie the broken-up spices and ground onion in a cloth bag and cook them in the 48 gallons of water for about an hour in order to extract the flavor. Then remove the bag of spices and add 32 pounds of sugar, the salt, and the tomato puree. Mix together the pectin, cornstarch, and the remaining 15 pounds of sugar and into this mixture stir the melted fat from the cooked pork and enough cold water to make a thin paste. Add this paste to the hot tomato-water-spice mixture and cook until the sauce loses its opaque-ness and becomes clear (about 5 minutes). Make up to 100 gallons.

Packaging: Fill the packages with 48 percent cooked beans and 52 percent sauce by weight; make allowance for, and include in each one-pound package, a piece of cooked pork which weighed one-half ounce before cooking. The finished pork and beans with these proportions contains 69 percent moisture, which is within the 70 percent legal limit for canned pork and beans.

Freezing and storage: Freeze and store at 0° F. or lower temperature.

Preparation for serving: Partially thaw the pork and beans in the package in order to prevent overcooking and mashing of the outside layer before the center portion is thawed during cooking. Heat to serving temperature in a casserole in the oven or in a double boiler on top of the stove.

Characteristics and Nutritive Values

When all of the ingredients were cooked together as is done in the canning procedure, the beans mashed badly and were difficult to package, the tomato was overcooked, and it was impossible to place uniform quantities of sauce and beans in each package. In the canning procedure, the starch from broken beans probably thickens the sauce but it was necessary in the procedure for freezing to add the cornstarch as a thickening agent. The pectin is added to prevent curdling of the sauce when it is thawed. The curdled appearance of the sauce made without pectin disappeared when the pork and beans were heated and stirred, but an unattractive product at any stage is considered undesirable, and therefore the inclusion of pectin in the formula is recommended.

The original pork must be of excellent quality; otherwise it may become rancid during prolonged storage. Because it seemed desirable to determine how well the fat would keep without waiting 9 to 12 months (the maximum storage period likely to be used in commercial practice) accelerated rancidity tests were made. Samples of frozen pork and beans containing good-quality fresh pork, salt pork, or smoked pork and other samples containing fresh pork treated with gum guaiac or with gum guaiac plus phosphoric acid, were held at room temperature and at 40° F. until deterioration of some part of the product occurred. In all samples the pork kept as long as the beans and sauce, as determined by eating tests and a quantitative

modified Kreis test for rancidity. The untreated fresh pork was the only sample for which the Kreis test indicated development of rancidity during 21 days of storage at 40° F. or 3 days at room temperature, and this one sample was slightly rancid to taste. In another series in which the original pork tasted slightly but definitely rancid to trained tasters after cooking but before freezing storage, the pork became more rancid during holding at 40° F. but it probably would have been considered edible by most people, even after the beans and sauce had spoiled. The results of the accelerated tests should not be interpreted as a recommendation for long storage at 40° F. Bacon gave markedly better flavor to the entire product than did fresh or salt pork and showed no deterioration at all after 21 days at 40° F.

It is important to know how long a frozen food can be held after it is removed from freezing storage. The experimental samples showed no significant growth of bacteria after 18 days at 40° F. nor after 1 day at room temperature, but the count had increased markedly by the second day at room temperature and the twenty-first day at 40° F. It does not follow that commercially packed products will behave in a similar manner. One commercial sample of frozen baked beans obtained at a local market showed a very high count (at least 1/2 million) when examined within a few hours after removal from the store holding cabinet. Even though each ingredient of the pork and beans is adequately cooked, the frozen product is not sterile. The paper packages are not sterile and there is opportunity for contamination of the cooked food during cooling and packaging. Food which is cooled rapidly is less likely to spoil than when it is cooled slowly because it is within the optimum temperature range for food spoilage bacteria for a shorter period. Every precaution should be taken to assure handling of these foods in as sanitary a manner as possible, especially after all cooking of the food is completed. The consistency of the product does not permit fast penetration of heat during preparation for the table following freezing, and therefore the final heating cannot be relied upon to destroy the organisms that may be present.

Analyses of the finished pork and beans indicated the following amounts of certain factors per 100 grams: 3.94 milligrams of ascorbic acid, 106 micrograms of thiamin, 20 micrograms of riboflavin, and 2.3 milligrams of iron. Calculations indicated approximately 157 calories. When beans were cooked for 75 minutes at 15 pounds of steam pressure (the period required to give a dark brown bean) the finished product made with these beans contained 26 micrograms of thiamin per 100 grams, only one-fourth as much as the samples containing beans cooked for 50 minutes at 15 pounds of steam pressure.

Finished pork and beans made with beans cooked for 3.5 hours in flowing steam contained 104 micrograms of thiamin per 100 grams, approximately the same as for the sample containing beans which were cooked for 50 minutes at 15 pounds of pressure. The beans of these two samples were also about the same in color. Although not so dark as those cooked for 75 minutes at 15 pounds of steam pressure, their color was considered

satisfactory. A sample of commercially canned pork and beans of the tomato-sauce type was analyzed and found to contain 58 micrograms of thiamin per 100 grams.

Since pork and beans are usually served as the main dish of a meal, rather large servings are used. Probably two-thirds of a pound (1.1 cup) would be an average serving for an adult. The Food and Nutrition Board of the National Research Council has made estimates of the quantities of various food constituents required by human beings. Of the daily requirement for a 154-pound man doing moderately active work or a 123-pound woman doing very active work, one serving of the pork and beans described here would supply 17 percent of the ascorbic acid, 17 percent of the thiamin, 2 percent of the riboflavin, 58 percent of the iron, and 16 percent of the calories.